

$$S = 1.05 \left[\frac{722.500 \times .02 \times 13.64 \text{ KHz}}{5.71} \right] = 36.2 \text{ MHz}$$

To this computed spectrum requirement, additional bandwidth must be added to account for statistical variation in channel occupancy. A 2 percent blocking factor for voice users was used. From the Erlang Tables³:

Additional Spectrum = 4.6 MHz

TOTAL SPECTRUM = 36.2 + 4.6 MHz
= 40.8 MHz

3.3 SPECTRUM REQUIREMENTS THROUGH YEAR 2010

The spectrum identified in Section 3.2 will meet the needs only through the year 2001. Reflected from past growth data, similar land mobile voice services have gained rapid and wide acceptance experiencing yearly growth rates exceeding 80 percent. Although a LEO MSS system is expected to have somewhat higher costs than current cellular land mobile voice systems, LEO MSS systems are, nonetheless, expected to grow rapidly. To compute future spectrum needs beyond 2001, a 10 percent growth rate was selected. This growth rate is very conservative compared to growth experienced by cellular systems but also includes future expected improvements in technology and frequency efficiency. Table 3 indicates the analogous spectrum requirements projected through 2010.

TABLE 3
LEO MSS SPECTRUM REQUIREMENTS
(MHz)

(YEAR 2001 - 2010)

<u>2001</u>	<u>2005</u>	<u>2010</u>
40.8	59.8	96.3

4. SUMMARY

This analysis establishes LEO MSS future spectrum requirements based upon the technical characteristics of a LEO MSS system. Information from a study of worldwide user demand in the areas to be served by such a system formed the basis to determine the spectrum necessary to accommodate peak busy hour needs. A conservative growth rate compared to growth experienced by similar systems, was used to project future LEO MSS spectrum requirements through the year 2010. These spectrum requirements are computed to be 40.8 MHz in 2001 increasing to 96.3 MHz by 2010.

³Sams, Howard W. & Co., Inc., Reference Data for Radio Engineers, p. 36-6:16 (1975).

ANNEX II

DEMAND FOR LOW EARTH ORBIT MOBILE SATELLITE SERVICE COMMUNICATIONS

1. Geographic Coverage

LEO MSS will provide global voice, data and position determination services on a continuous basis to all points on the earth's surface. This capability to provide worldwide service is the critical factor to LEO MSS commercial viability - LEO MSS has the capability to serve many niche user markets with a single infrastructure. In fact, LEO MSS may provide the only mobile communications services to many rural global locations.

a. Developing Countries

LEO MSS has the potential to well serve developing countries. These countries have approximately three billion inhabitants, or 60 percent of the world population. Inadequate telecommunications infrastructure in many developing nations is a major obstacle to their further economic development. LEO MSS services will help promote the economies of the developing world by providing modern, reliable telecommunications service to nations without the need for large infrastructure investments. Several developing countries have very large numbers of their inhabitants in rural areas with no access to any type of telephone service. To ameliorate this problem, these governments could provide portable public LEO MSS telephone booths in rural areas. LEO MSS would provide an excellent yet inexpensive solution to servicing these areas because the only infrastructure costs of providing service would be the phone booth and a LEO MSS terminal.

b. New Market Economies

New market economies have a significant need for modern mobile telecommunications services. Although these nations have industrialized economies, their telecommunications infrastructure do not satisfy existing demand and are not adequate for the increased commercial activity they are likely to enjoy as their economies are liberalized. The telecommunications capabilities of the LEO MSS system could assist these nations as they modify their political structures and liberalize their economies.

c. Maritime and Aeronautical Coverage

LEO MSS has the potential to serve domestic and worldwide maritime and aeronautical markets. This coverage will include the far reaches of aeronautical polar routes. These markets could enjoy the full range of mobile telecommunications services, including voice, data, and position determination.

d. Rural and Mobile Service Markets

There are also many rural portions of developed countries that may never have terrestrial cellular telephone service because of sparse population coverage and remote locations. Many million people worldwide live in these areas. LEO MSS could offer these citizens sophisticated mobile telecommunications services unavailable from terrestrial systems.

2. Voice and Data Services

LEO MSS will not compete with the public switched telephone network ("PSTN") and terrestrial cellular systems primarily because of its rate structure. Instead, LEO MSS has the potential to provide service to locations that do not otherwise have access to the PSTN or terrestrial cellular services. Major applications of LEO MSS include governmental communications, international travel, commercial air travel, general and business aircraft, recreational vehicles, pleasure boats, coastal and inland shipping, construction and oil and mineral exploration, and private rural mobile service users.

a. Governmental Communications

Unlike terrestrial systems, LEO MSS is immune to the effects of natural disasters on the earth. Users could employ LEO MSS systems in emergency situations such as earthquakes, hurricanes, tornados, floods, etc. Governments could use LEO MSS as a secondary communications systems in situations where standard communications services are inconvenient or impossible to access. Also governments has the opportunity to employ LEO MSS extensively for emergency services as well as communication from areas without telephone service.

b. International Travel

Business people travelling to many developing countries could rely on LEO MSS voice and data terminals, in addition to paging units, since sophisticated and reliable communications services are not always available in these countries.

c. Commercial Air Travel

LEO MSS global coverage offer reliable telephone, data and position determination services to commercial aircraft at all geographic latitudes, including flights on polar air routes. The installation of terminal units will not require steerable antennas. Low gain antennas, including flush mounted antennas, may be used for this purpose. As a result LEO MSS could offer significant advantages over existing commercial air travel communications systems.

There are approximately 5,000 air carrier aircraft in the United States. Eventually, most of these aircraft could have in-flight public telephone service. A low-earth orbit system provides better coverage and lower cost receivers than land-based and geostationary-orbit based in-flight telephones. It is anticipated that LEO MSS will capture up to 50 percent of the in-flight telephones service on a worldwide basis.

d. General Aviation

There are approximately 200,000 general aviation aircraft in the United States. It is expected that equipage with LEO MSS communications and position determination would be at least that of similarly priced equipment, such as a LORAN-C receiver, which would result in 60,000 users for general aviation aircraft. The international market is expected to add another 40,000 users.

e. Business Aviation

Continuous and high-quality data and voice service is presently not readily available to business aircraft. LEO MSS could fill this void by providing voice, facsimile and data services for a complete flying office.

There are approximately 10,000 turbo prop and turbo jet business aircraft in the United States. By 2001, this number is expected to increase to 14,000 aircraft. Given the need for reliable communications at all times and the generally high value of information being communicated, approximately 50 percent of these business aircraft, or 7,000 customers, could use LEO MSS systems. An estimated 2,000 users may be drawn from other owners of business aircraft.

f. Recreational Vehicles

There are approximately eight million recreational vehicles in the United States. LEO MSS service could provide owners of these vehicles with reliable telephone service in remote locations, such as camps, parks and rural roads. A hand-held phone could also be used for hiking and other recreational activities. Consumers of higher-priced recreational vehicles are prime candidates for becoming LEO MSS users. Users within the U.S. are expected to number 400,000. Recreational vehicles outside the U.S. are expected to contribute another 100,000 users.

g. Pleasure Boats

There are approximately ten million pleasure boats in the United States. In the luxury class (greater than 26 feet long) there are an 300,000 pleasure craft. Approximately 70 percent of these luxury craft, or 210,000, are expected to use LEO MSS services. There should be a similar rate throughout the world.

h. Coastal and Inland Shipping

Today, ships travelling on the U.S. coast, rivers, canals and lakes lack affordable, reliable and continuous communications service. LEO MSS could provide inexpensive voice, facsimile and data services in this market. There are approximately 30,000 ships in the United States which fall into this category. LEO MSS could provide a lower cost option for mobile communication services. An estimated 20 percent, or 6,000 users could use these services. Another 40,000 coastal and inland shipping users are estimated on a worldwide basis.

i. Construction and Oil and Mineral Exploration

LEO MSS could provide critical voice and data systems to remote construction and natural resource exploration sites, including offshore points. Reliable telecommunications services will improve the efficiency of these businesses. The U.S. market is estimated at 5,000 users, with another 15,000 throughout the world.

j. Public Telephone

Remote areas in developed and developing countries have no telephone service. LEO MSS is ideally suited for these situations since the satellite infrastructure will be provided immediately and at no cost. Only ground terminals would be needed to begin service. The estimates of people with no access to telephone service range from one to two billion people. Assuming one public phone per 2,000 people, there is a potential market of up to one million users. It is estimated that 300,000 users could obtain LEO MSS service.